FIG. 1

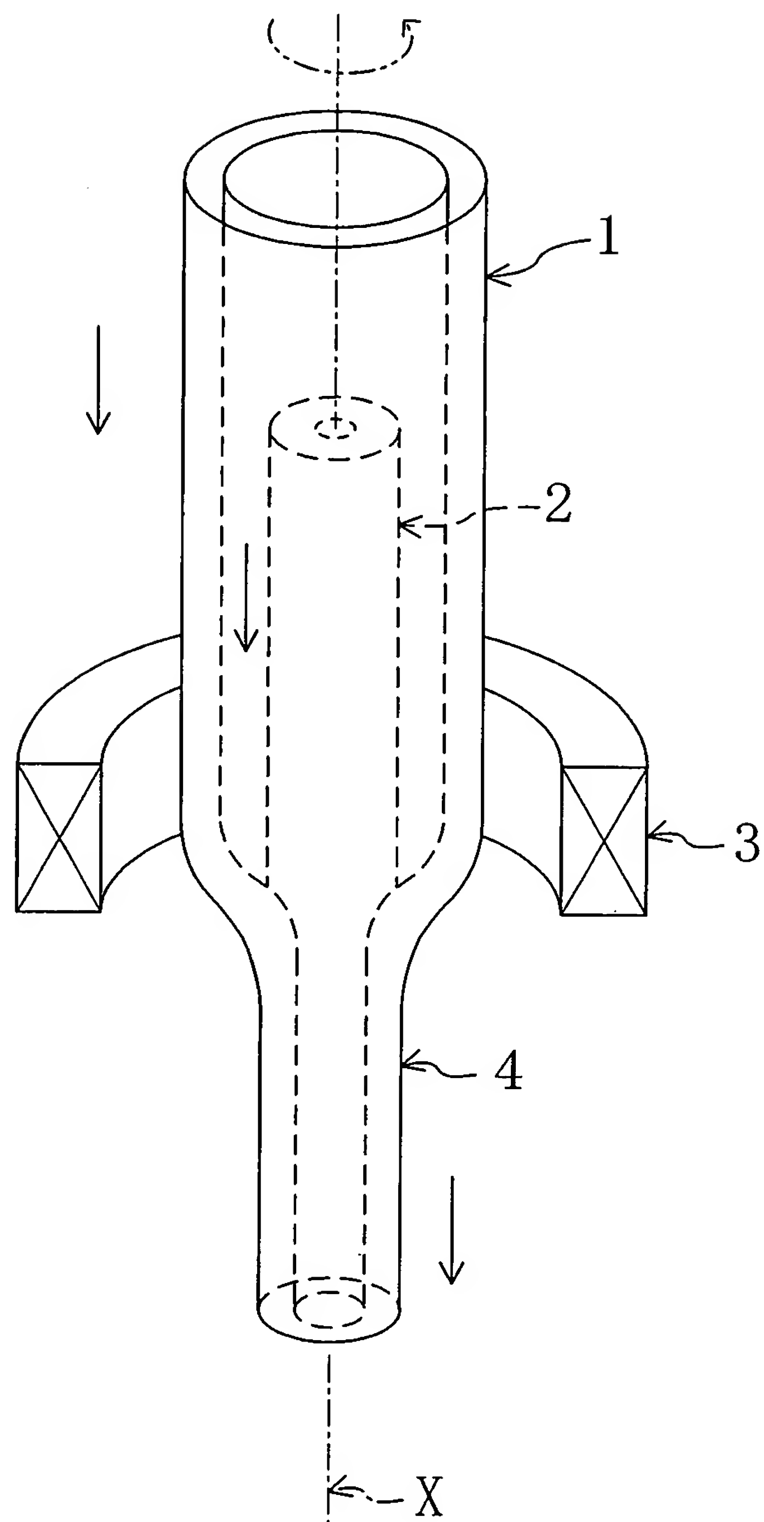

FIG. 2

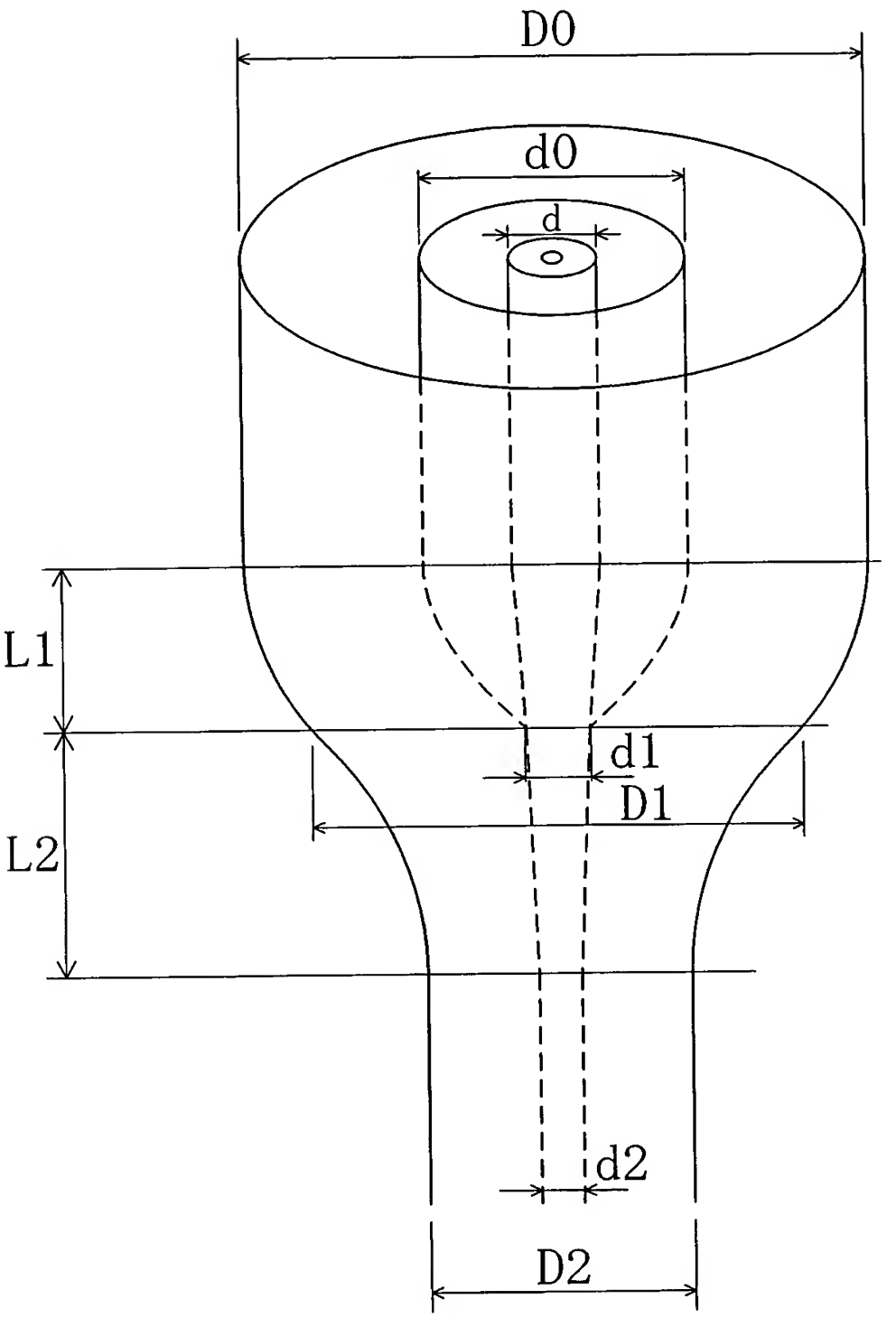

FIG. 3

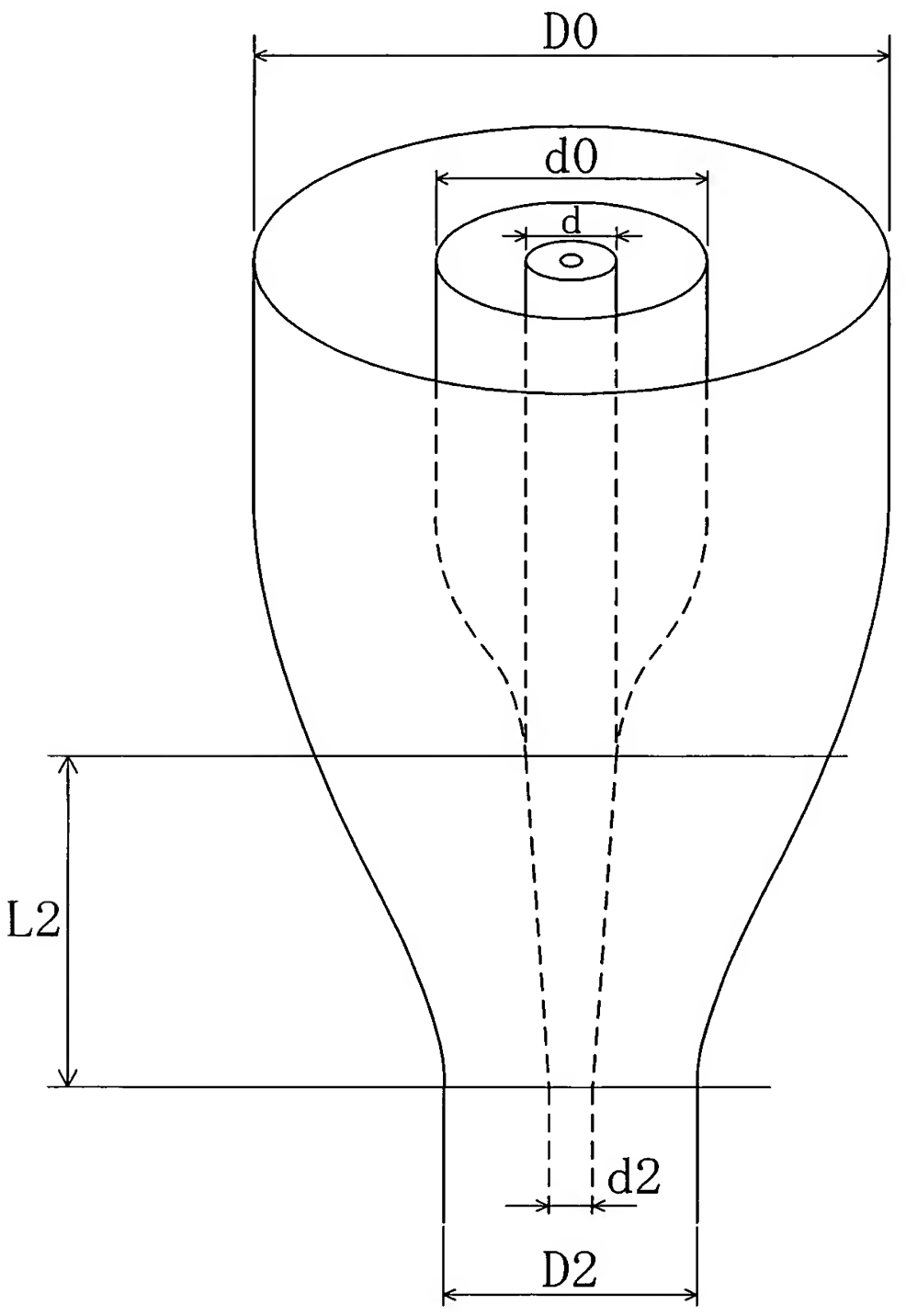

FIG. 4

	variable	Conv. Ex. 1	Work. Ex. 1	Work. Ex. 2	Work. Ex. 3	Work. Ex. 4	Work. Ex. 5	Comp. Ex. 1	Conv. Ex. 2	Work. Ex. 6	Work. Ex. 7	Work. Ex. 8
pipe outer diameter	D0	67.0	48.0	67.0	67.0	67.0	67.0	67.0	170.0	170.0	166.0	170.0
pipe inner diameter	d0	23.0	24.0	23.0	23.0	23.0	23.0	23.0	55.0	55.0	66.0	55.0
rod diameter	d	19.0	13.0	19.0	19.0	19.0	19.0	19.0	45.0	45.0	41.6	45.0
pipe inner/outer diameter ratio	d0/D0	0.34	0.50	0.34	0.34	0.34	0.34	0.34	0.32	0.32	0.40	0.32
pipe outer diameter	D1	65.7	41.0	51.2	60.3	58.2	48.4	44.0	167.0	157.5	128.2	98.6
pipe inner diameter (=rod diameter)	d1	19.0	12.2	14.8	17.4	16.8	14.0	12.7	45.0	42.4	33.8	26.6
pipe inner/outer diameter ratio	d1/D1	0.29	0.30	0.29	0.29	0.29	0.29	0.29	0.27	0.27	0.26	0.27
pipe outer diameter	D2	44.0	30.0	44.0	44.0	44.0	44.0	44.0	60.0	60.0	60.0	60.0
pipe inner diameter (=rod diameter)	d2	12.7	9.0	12.7	12.7	12.7	12.7	12.7	16.2	16.2	15.8	16.2
pipe inner/outer diameter ratio	d2/D2	0.29	0.30	0.29	0.29	0.29	0.29	0.29	0.27	0.27	0.26	0.27
ratio of pipe inner/outer diameter ratios	$\frac{(d0/D0)}{(d1/D1)}$	1.19	1.68	1.19	1.19	1.19	1.19	1.19	1.20	1.20	1.51	1.20
initial stretching position to integrated position	L1	0	38	43	18	22	89	210	0	66	140	377
integrated position to final stretching position	L2	85	79	88	92	89	22	0	400	344	245	33
ratio of distance to integrated position over total distance	L1/(L1+L2)	0.00	0.32	0.33	0.16	0.20	0.80	1.00	0.00	0.17	0.36	0.92
pipe pressure reduction level (kPa)		100.0	13.3	13.3	53.3	26.6	6.7	3.3	100.0	40.0	13.3	3.3
heating temperature of stretching furnace (℃)		2250	2250	2250	2250	2250	2250	2250	2250	2250	2250	2250
feed rate of pipe into furnace (mm/min)		10.0	8.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
draw rate of stretched preform (mm/min)		22.3	16.9	22.3	22.3	22.3	22.3	22.3	77.5	77.5	69.3	77.5
bubbles in preform (per 100mm of preform)		0	0	0	0	0	2	124	0	1	1	12
mode field eccentricity amount of optical fiber (μm)		1.41	0.20	0.19	0.22	0.20	0.18	0.19	2.22	0.33	0.28	0.29

FIG. 5

	variable	Conv. Ex. 1	Work. Ex. 9	Work. Ex. 10	Work. Ex. 11	Work. Ex. 12	Conv. Ex. 2	Work. Ex. 13	Work. Ex. 14
pipe outer diameter	D0	67.0	67.0	67.0	67.0	67.0	170.0	170.0	170.0
pipe inner diameter	d0	23.0	23.0	23.0	23.0	23.0	55.0	55.0	55.0
rod diameter	d	19.0	6.0	10.8	13.3	21.0	45.0	25.0	50.0
pipe inner/outer diameter ratio	d0/D0	0.34	0.34	0.34	0.34	0.34	0.32	0.32	0.32
pipe outer diameter	D1	65.7	54.0	55.2	56.9	59.2	167.0	128.0	149.5
pipe inner diameter (=rod diameter)	d1	19.0	5.1	9.3	11.8	18.7	45.0	19.7	44.4
pipe inner/outer diameter ratio	d1/D1	0.29	0.09	0.17	0.21	0.32	0.27	0.15	0.30
pipe outer diameter	D2	44.0	44.0	44.0	44.0	44.0	60.0	60.0	60.0
pipe inner diameter (=rod diameter)	d2	12.7	4.2	7.4	9.1	13.9	16.2	9.2	17.8
pipe inner/outer diameter ratio	d2/D2	0.29	0.09	0.17	0.21	0.32	0.27	0.15	0.30
ratio of pipe inner/outer diameter ratios	$\frac{(d0/D0)}{(d1/D1)}$	1.19	3.62	2.03	1.66	1.08	1.20	2.11	1.09
initial stretching position to integrated position	L1	0	77	62	54	32	0	140	94
integrated position to final stretching position	L2	85	138	121	108	125	400	270	271
ratio of distance to integrated position over total distance	L1/(L1+L2)	0.00	0.36	0.34	0.33	0.20	0.00	0.34	0.26
pipe pressure reduction level (kPa)		100.0	13.3	13.3	13.3	13.3	100.0	13.3	13.3
heating temperature of stretching furnace (℃)		2250	2250	2250	2250	2250	2250	2250	2250
feed rate of pipe into furnace (mm/min)		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
draw rate of stretched preform (mm/min)		22.3	20.6	21.1	21.4	22.7	77.5	73.6	78.8
bubbles in preform (per 100mm of preform)		0	1	1	0	1	0	0	1
mode field eccentricity amount of optical fiber (μm)		1.41	0.49	0.44	0.21	0.19	2.22	0.42	0.28

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FIG. 6

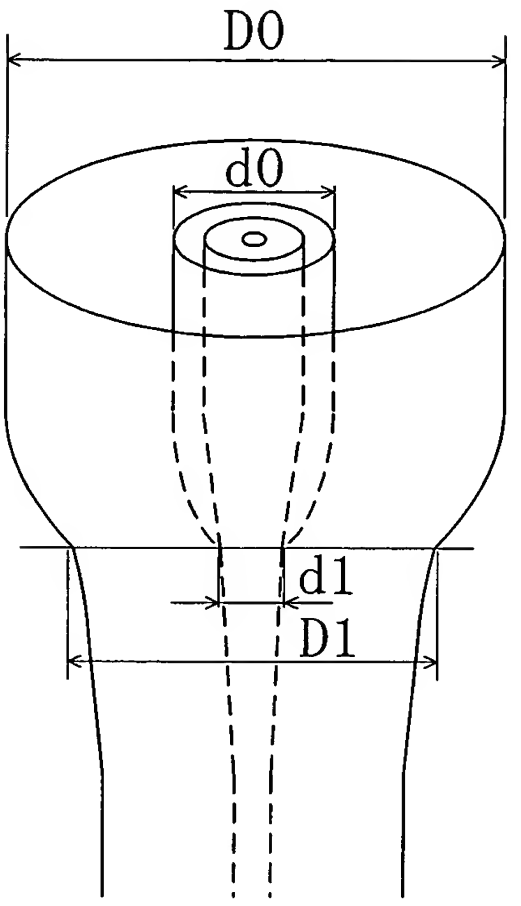

FIG. 7

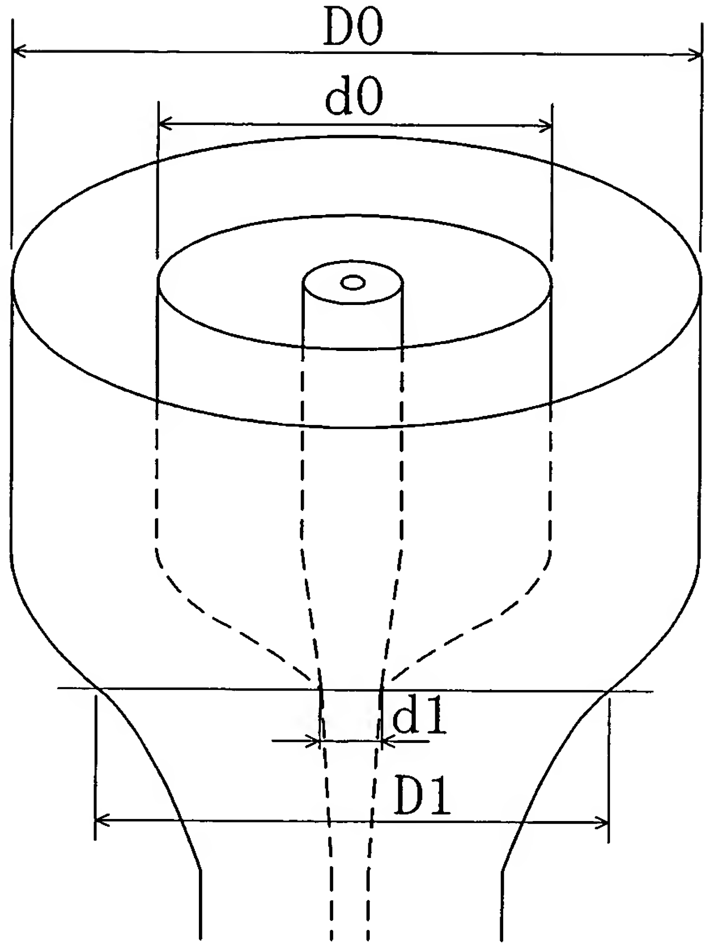

FIG. 8

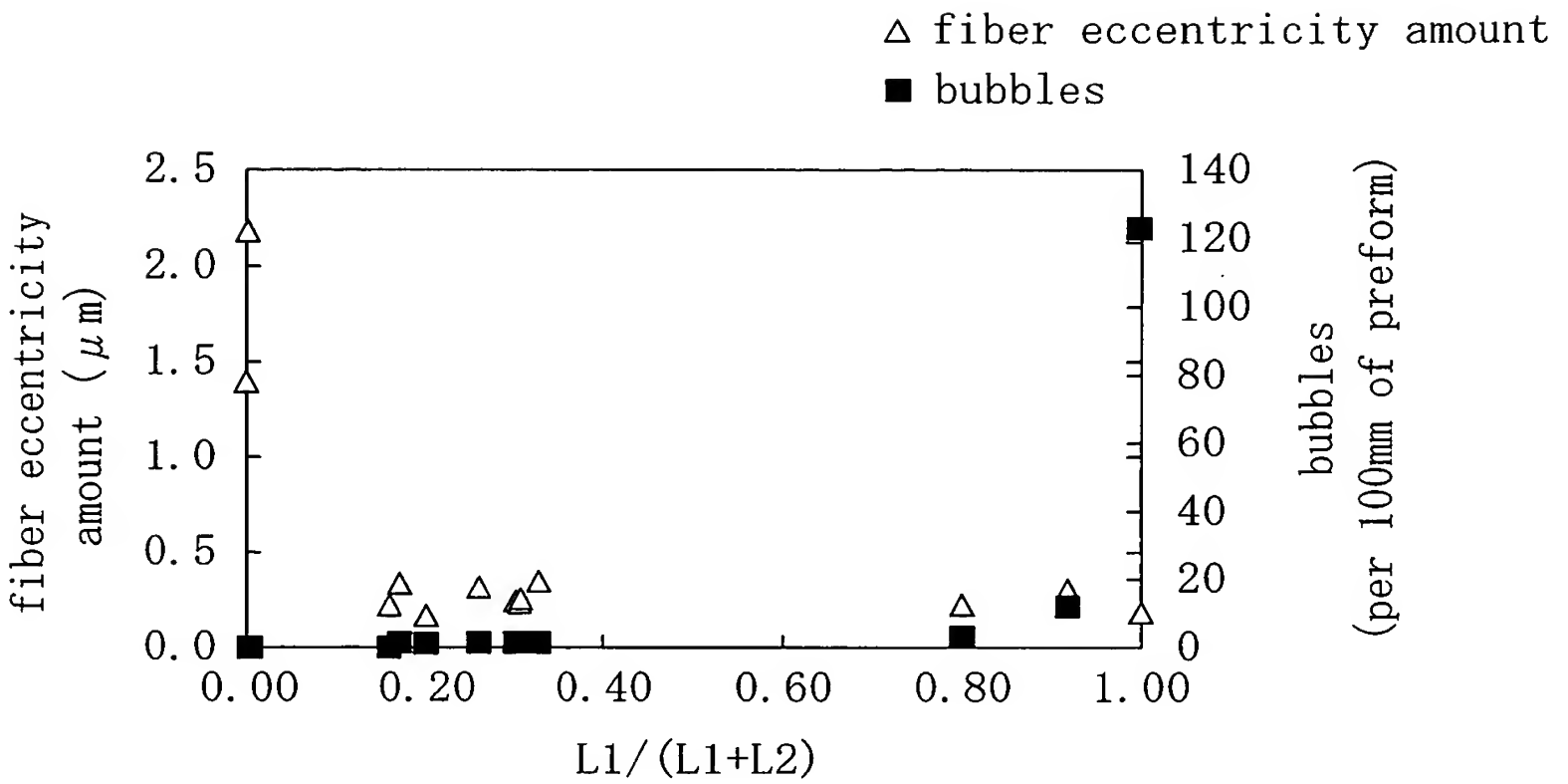

FIG. 9

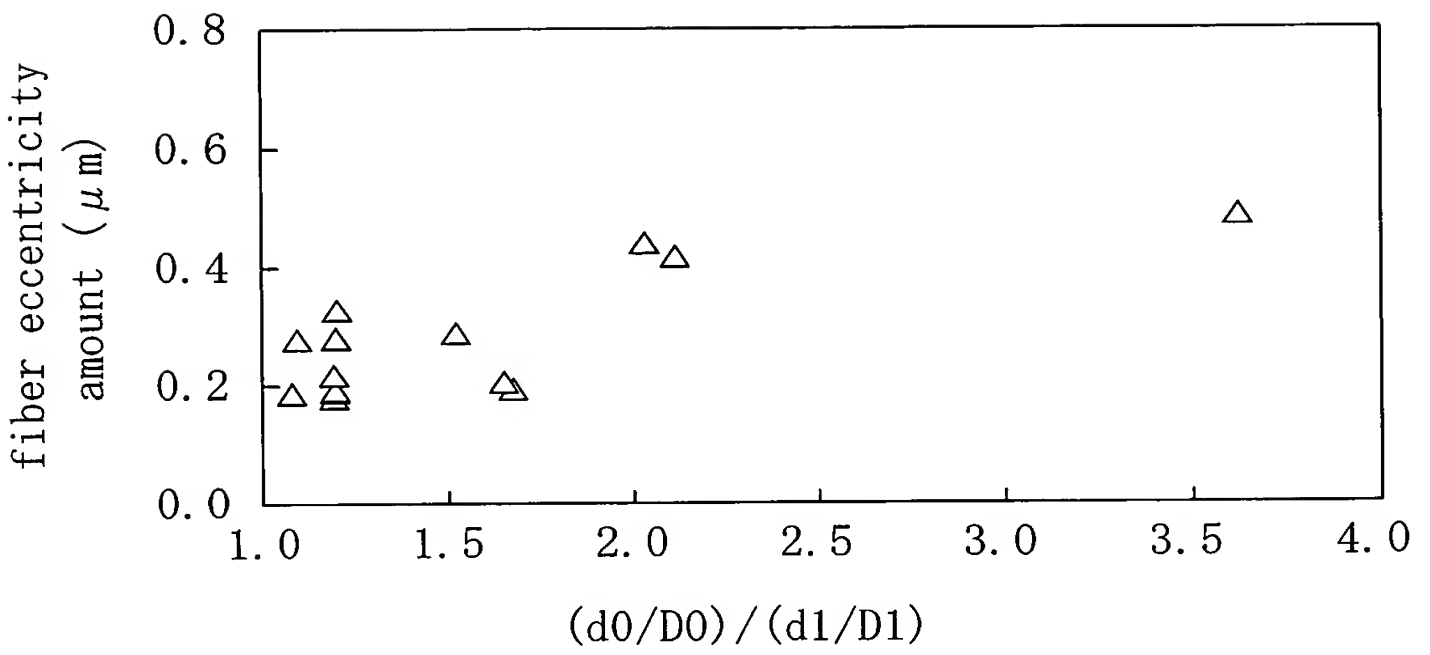
fiber eccentricity amount (μm)
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
(d0/D0)/(d1/D1)

FIG. 10

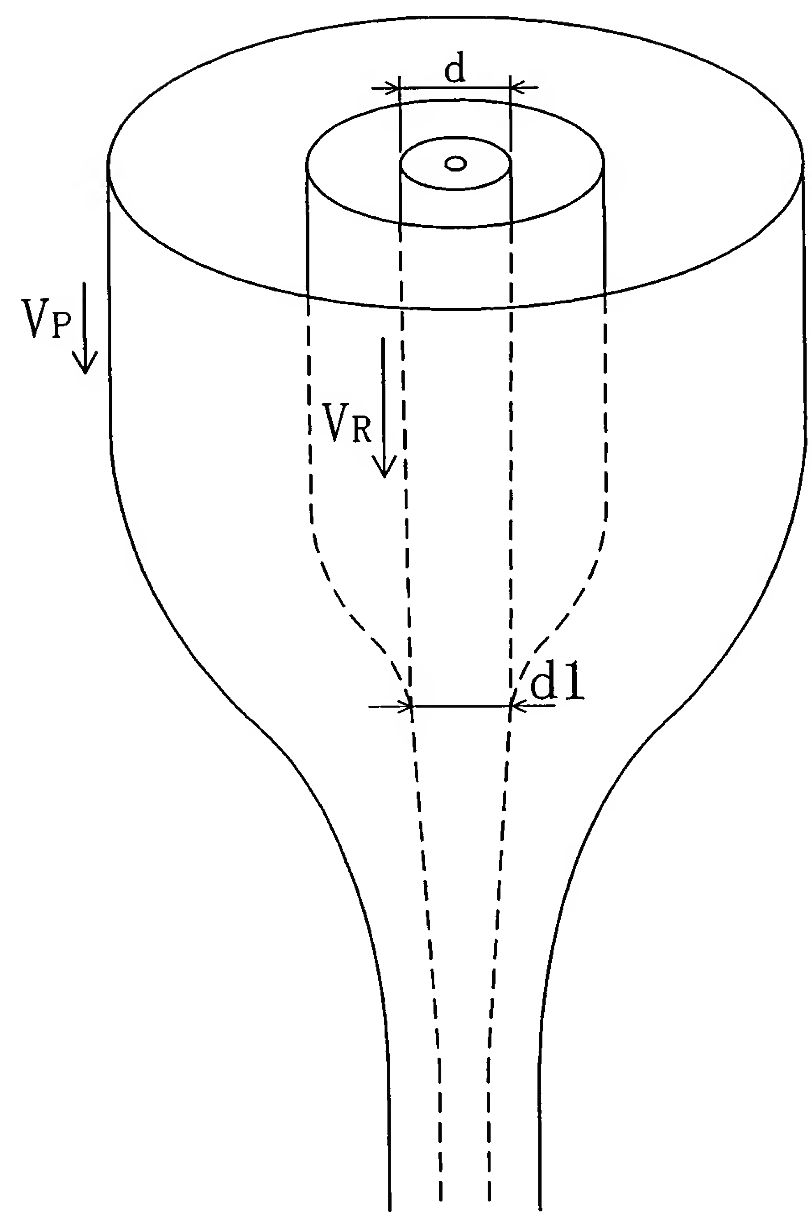

FIG. 11

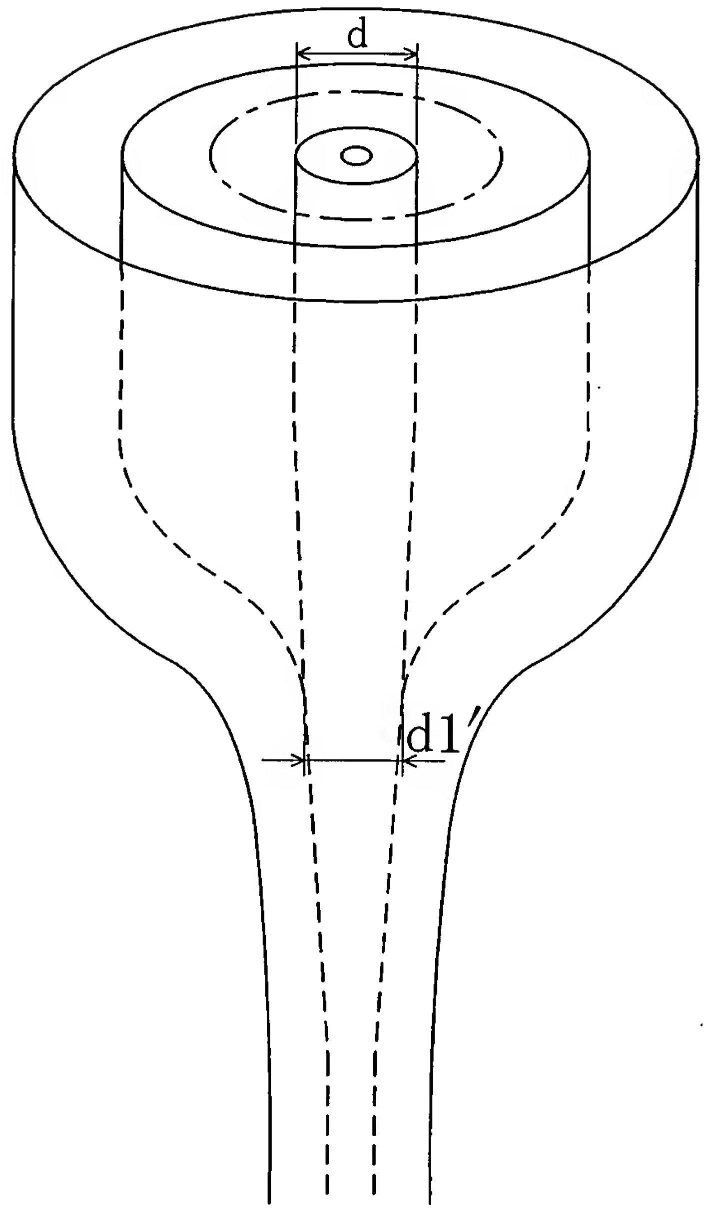

FIG. 12

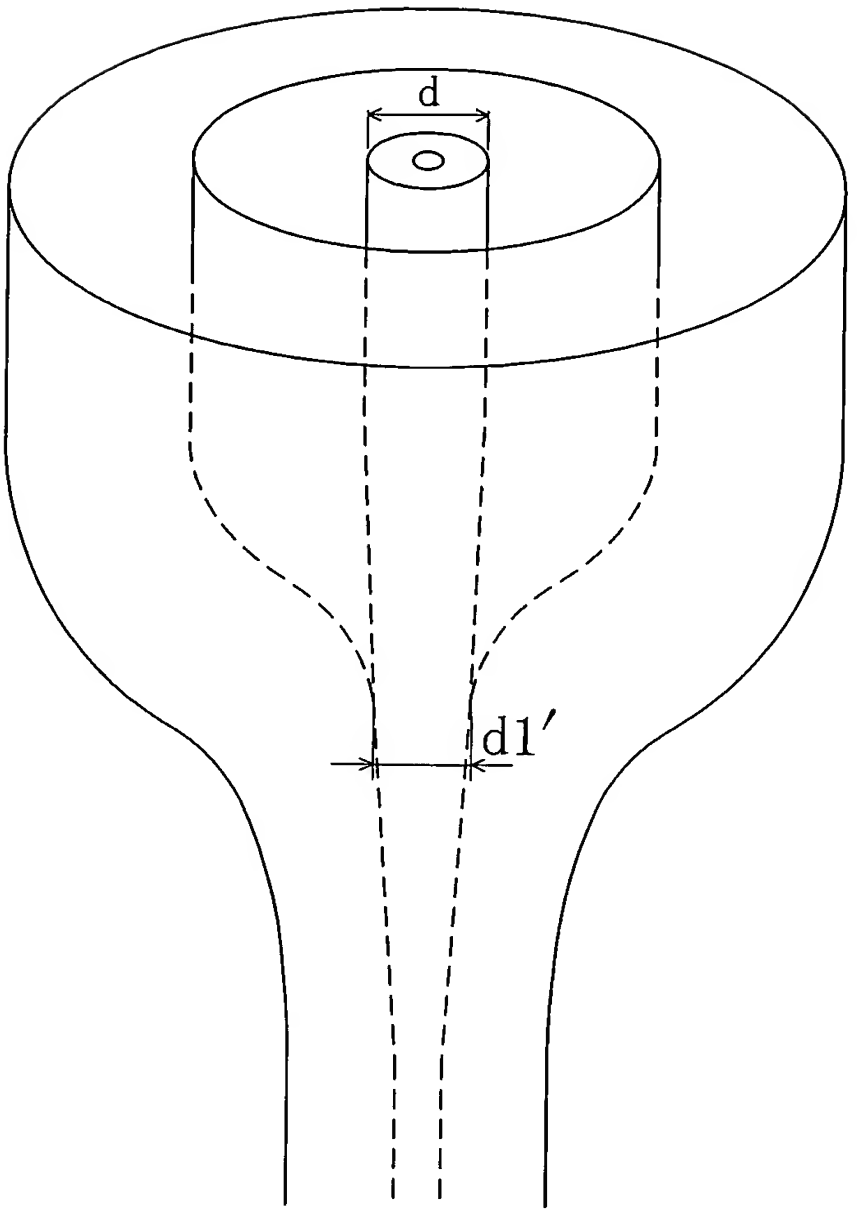

FIG. 13

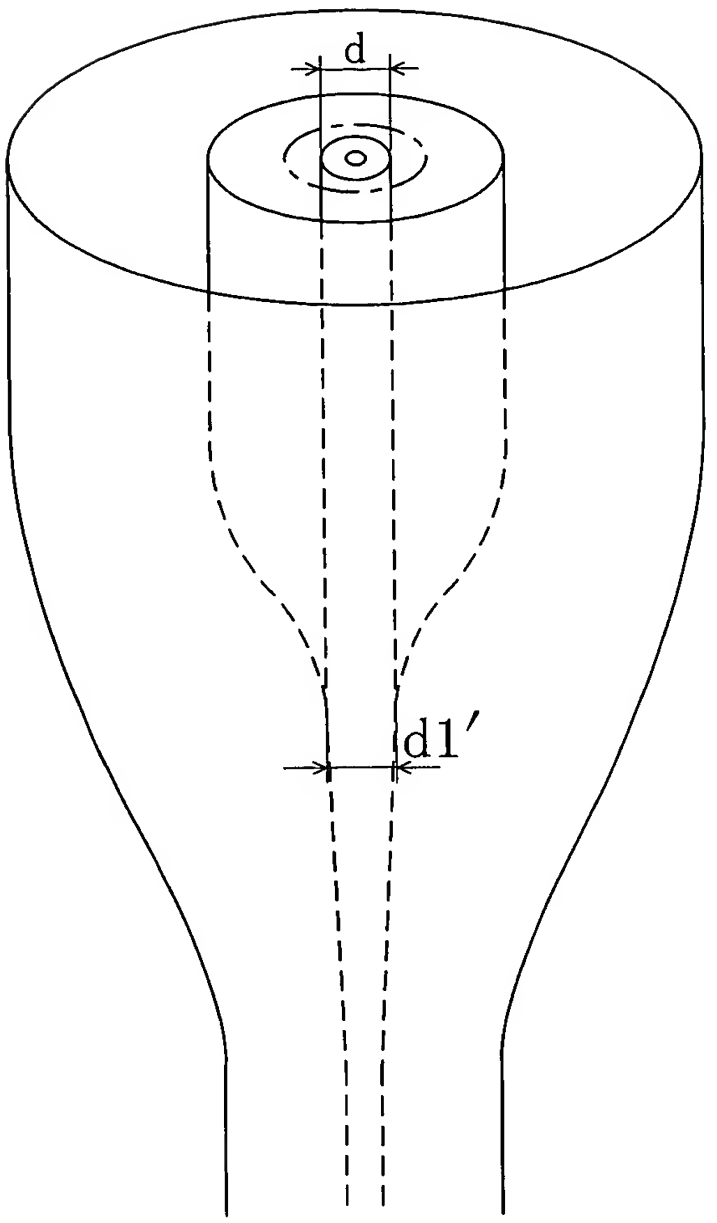

FIG. 14

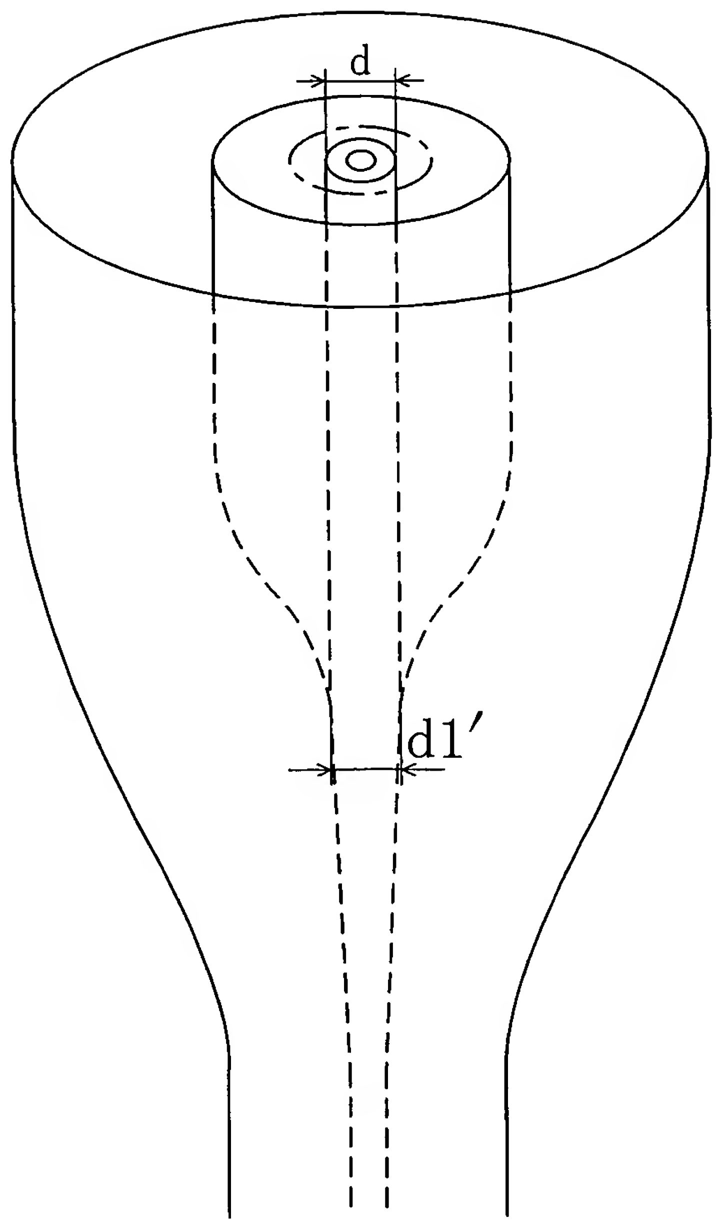

FIG. 15

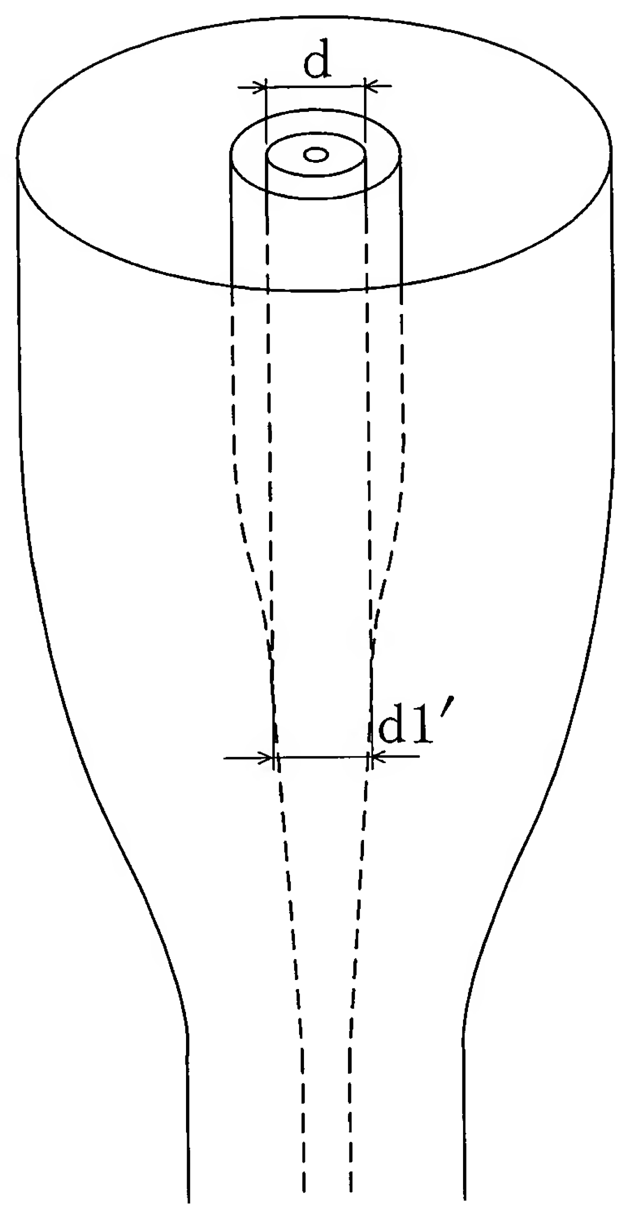

FIG. 16

item	variable	unit	Work. Ex. (corresponds to FIG. 10)	Comp. Ex. 1 (corresponds to FIG. 13)	Comp. Ex. 2 (corresponds to FIG. 12)	Comp. Ex. 3 (corresponds to FIG. 15)
VAD rod outer diameter	d	(mm)	32.0	32.0	48.0	48.0
core diameter		(mm)	8.65	8.65	12.47	12.15
VAD rod C/C			3.70	3.70	3.85	3.95
pipe inner diameter		(mm)	53.0	53.0	70.0	55.0
clearance		(mm)	10.5	10.5	11.0	3.5
rod feed rate	V_R	(mm/min)	18.5	10.0	10.0	10.0
pipe feed rate	V_P	(mm/min)	10.0	10.0	10.0	10.0
pipe outer diameter		(mm)	168.5	168.5	189.0	175.1
(rod/pipe) feed rate ratio	V_R/V_P		1.85	1.0	1.0	1.0
outer diameter at integrated position			115.4	107.2	128.0	122.8
rod diameter at integrated position	d1	(mm)	30.3	—	—	—
rod diameter at integrated position	d1′	(mm)	—	21.0	33.8	34.1
completed preform C/C			14.1	18.9	14.6	14.2
target preform C/C			14.2	14.2	14.4	14.4
cut-off wavelength		(μm)	1.270	1.700	1.298	1.266
bubbles in preform	(per 100 mm length of preform)		0	0	0	67
mode field eccentricity amount of optical fiber		(μm)	0.25	unknown	1.22	0.24